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MFM study of switching magnetization in particles with configurational anisotropy obtained by the microsphere lithography

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The triangular or square ferromagnetic particles with configurational anisotropy of shape can be in several quasi-homogeneous stable states of magnetization. The states are separated by rather high energy barriers that ensure their stability in time. It is possible to use such the particles for creating magnetoelastic random access memory cells – MeRAM [1]. The memory cell of this type can store not one, but several bits of information [2]. Previously the magnetic properties of the particles with configurational anisotropy made by scanning probe lithography were studied in our laboratory [3].

In this work, the quasi-homogeneous states of triangular permalloy particles was studied by magnetic force microscopy with depend on particles size and shape. The particles were made by the microsphere lithography technique. The lithographic mask was a monolayer of close-packed microspheres diameter 2.35 and 5 μm. This lithographic method makes it possible to form particles of identical size and shape with concave sides.

The particular attention was paid to the switching of the magnetization of particles from one quasi-homogeneous state to another under external magnetic field. The values of the switching fields and processes of magnetization reversal of ferromagnetic particles of two types were compared. The particles of first type were made by scanning probe lithography [3] while the particles of second type prepared by microsphere lithography.

It is established that particles obtained by using microspheres with a diameter of 5 μm have a vortex magnetization structure. The particles obtained by using microspheres with a diameter of 2.35 μm, have a quasi-homogeneous magnetization. In addition, the magnetization reversal of such particles in an external magnetic field always occurs through an intermediate quasi-homogeneous state of magnetization.

For the similar particles that were made by scanning probe lithography the magnetization reversal occurred stepwise without transition to the intermediate quasi-homogeneous state [3]. When the magnetization reversal of particles occurs through the intermediate stable state the magnitude of switching field are increases. This is probably due to the magnetic interaction between particles made by microsphere lithography. The magnitude of interaction is determined by the distance between particles and close packing of microspheres.

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1. A.A. Bukharaev, A.K. Zvezdin, A.P. Pyatakov, Yu.K. Fetisov, *Phys. Usp.* **61**, 1175 (2018).
2. M. Salehi-Fashami, N. D'Souza, *J. Magn. Magn. Mater.* **438**, 76 (2017).
3. D.A. Bizyaev, A.A. Bukharaev, A.P. Chuklanov, N.I. Nurgazizov, *Phys. Solid State* **60**(11), 2194 (2018).